CBCS SCHEME

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BMATM101

First Semester B.E./B.Tech. Degree Examination, Jan./Feb. 2023
Mathematics – I for Mechanical Engineering Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	With usual notations prove that $\tan\phi = \frac{r d\theta}{dr}$.	6	L2	CO1
	b.	Find the pedal equation of $r^n = a^n \cos n\theta$	7	L2	CO1
	c.	Find the angle of intersection of the curves $r = a(1+\cos\theta)$, $r = b(1-\cos\theta)$	7	L2	CO1
		OR			
Q.2	a.	Derive the radius of curvature for the Cartesian curve.	7	L2	CO1
	b.	Find the angle between the polar curves $r = a\log\theta$, $r = \frac{a}{\log\theta}$	8	L2	CO1
	c.	Using modern mathematical tool write a program/code to plot sine and cosine curves.	5	L3	CO5
		Module – 2			
Q.3	a.	Expand $\sqrt{1+\sin 2x}$ by Maclaurin's series upto the terms containing x^4.	6	L2	CO2
	b.	If $U = f(x-y, y-z, z-x)$, show that $\frac{\partial U}{\partial x} + \frac{\partial U}{\partial y} + \frac{\partial U}{\partial z} = 0$.	7	L2	CO2
	c.	Examine the function $f(x,y) = x^3 + 3xy^3 + 15x^2 - 15y^2 + 72x$ for extreme values.	7	L3	CO2
		OR			
Q.4	a.	Evaluate $\lim_{x\to 0}\left(\frac{a^x + b^x + c^x + d^x}{4}\right)^{\frac{1}{x}}$.	6	L2	CO2
	b.	If $U = x^2 + y^2 + z^2, V = xy + yz + zx, W = x + y + z$, find $\frac{\partial(U,V,W)}{\partial(x,y,z)}$.	7	L2	CO2
	c.	Using modern mathematical tool to write a program/code to evaluate $\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$	7	L3	CO5
		Module – 3			
Q.5	a.	Solve $\frac{dy}{dx} + \frac{y\cos x + \sin y + y}{\sin x + x\cos y + x} = 0$.	6	L2	CO3
	b.	If the air is maintained at 30°C and the temperature of the body cools from 80°C to 60°C in 12 minutes, Find the temperature of the body after 24 minutes.	7	L3	CO3
	c.	Find the general and singular solutions of $xp^2 + xp - yp + 1 - y = 0$.	7	L2	CO3

OR

Q.6	a.	Solve $\frac{dy}{dx} + x\sin 2y = x^3\cos^2 y$.	6	L2	CO3
	b.	Show that the parabola $y^2 = 4a(x + a)$ is self orthogonal.	7	L3	CO3
	c.	Solve $xyp^2 - (x^2 + y^2)p + xy = 0$.	7	L2	CO3
		Module – 4			
Q.7	a.	Solve $(D^4 - 4D^3 + 8D^2 - 8D + 4)y = 0$.	6	L2	CO3
	b.	Solve $(D^2 - 6D + 9)y = 6e^{3x} + 7e^{-2x} - \log 2$.	7	L2	CO3
	c.	Solve by variation of parameters $(D^2 + 1)y = \text{Sec } x$.	7	L2	CO3
		OR			
Q.8	a.	Solve $(D^2 - 4D + 13)y = \text{Cos } 2x$.	6	L2	CO3
	b.	Solve $y'' + 3y' + 2y = 12x^2$.	7	L2	CO3
	c.	Solve $(x^2)y'' - xy' + y = \log x$.	7	L2	CO3
		Module – 5			
Q.9	a.	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 1 \\ 2 & 1 & -1 & 0 \\ 3 & 3 & 2 & 1 \\ 2 & 4 & 6 & 2 \end{bmatrix}$	6	L2	CO4
	b.	For what values λ and μ the system equations, $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$, $2x + 3y + \lambda z = \mu$, has i) No solution ii) a unique solution iii) infinite number of solutions.	7	L2	CO4
	c.	Solve the system of equations using Gauss Seidel method by taking (0, 0, 0) as an initial conditions $10x + y + z = 12$, $x + 10y + z = 12$, $x + y + 10x = 12$.	7	L2	CO4
		OR			
Q.10	a.	Using Gauss – Jordon method, solve $x + y + z = 11$, $3x - y + 2z = 12$, $2x + y - z = 3$.	7	L2	CO4
	b.	Using Rayleigh's power method find the dominant eigen value and the corresponding eigen vector of $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ by taking $[1 \ 0 \ 0]^T$ as the initial eigen vector. [Carry out 6 iterations].	8	L2	CO4
	c.	Using modern mathematical tool write a program/code to test the consistency of the equations $x + 2y - z = 1$, $2x + y + 4x = 2$, $3x + 3y + 4z = 1$.	5	L3	CO5

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